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FUEL CELL
[Nenryo denchi]

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Claims

1. In a fuel cell that is constructed by placing in multiple individual layers single cells made up of an oxide electrode and a fuel electrode used as a gas dispersion electrode that are arranged on both sides enclosing the matrix; a fuel cell characterized in that in addition to forming mutual gas chambers between them by aligning single cells that contact one another so that the electrodes of the same polarity face each other, a cross-over lead is lead out from the electrode at each single cell, and the single cells are mutually electrically connected through the medium of these leads.

2. A fuel cell according to Claim 1 characterized in that the common gas chamber has a gas inlet and outlet for a reactive gas, and is constructed by a frame in the shape of a picture frame corresponding to the electrode outer shape in which at least the face contacting the single cell [illegible] electrode is electrically insulated.

Detailed explanation of the invention

Industrial application field

This invention relates to a stacked type fuel cell that constitutes a cell stack by stacking multiple individual single cells made of a matrix layer holding an electrolyte, a fuel electrode, and an oxidizer electrode, and which generates electricity by supplying fuel and an oxidizing reactive gas from an external section to the fuel electrode and the oxidizer electrode of each single cell.

Prior technology

First, with the phosphoric acid type fuel cell taken as the object, a cell stack construction of a fuel cell of the ribbed separator type is shown in Figure 3. In the figure, (1) is a single cell, (2) a separator, and the cell stack is constructed by alternately stacking the single cell (1) and the separator (2).

Here, the single cell (1) is made as a laminated body of a matrix layer (3) that holds an electrolyte, and a fuel electrode (4) and an oxidizer electrode (5) that are arranged on both sides of it sandwiching the matrix layer (3). An electrode catalytic layer (7) is laminated on top of the flat face of the respective gas permeable ribbed electrode substrate (6) of the fuel electrode (4) and the oxidizer electrode (5) and a reactive gas passage (8) is framed on the rib section of the ribbed electrode substrate (7).

The separator (2) is a gasimpermeable conductive thin plate that is made of a carbon material such as glassy carbon, and in addition to preventing the mixing of the reactive gases by mutually isolating the reactive gas passage (8) for the fuel electrode (4) side from the oxidizer electrode (5) side between adjacent single cells (1), it has the function of making a mutually conductive connection among the single cells (1).

In contrast to a cell stack of this type of construction, a means of generating electricity from the electromotive reaction resulting from an oxygen-rich reforming gas as fuel at each single cell (1) from an external section to the reactive gas passage (8) of its fuel electrode (4) side, and air as an oxidizing gas to a reactive gas passage (8) of the oxidizer electrode (5), is commonly known. Also, in this case, as shown by the fuel cell in Figure 3, single cells (1) are connected in series with the separator (2) interposed between them, and the equivalent circuit of the internal wiring of the fuel cell becomes like that of Figure 4.

Problems the invention is to solve

However, in the fuel cell of the construction used in the past shown in Figure 3, there are the following types of problems. Namely,

(1) With respect to the separator (2), besides heat resistance, corrosion resistance, and lowering of electrical resistance, in order to achieve compactness by lowering the lamination height of the cell stack,

it is necessary to make the separator as thin as possible. Therefore, as was previously stated, the mechanical strength of a separator made of glassy carbon is low, and trouble frequently resulted, such as cracks being generated in the separator and breaking at the time of assembly and tightening of the separator. Moreover, with damage to this type of separator, the isolation function of the reactive gas was lost, creating a source for mixing of the fuel gas and the oxidizer gas, and the reliability of the fuel cell was lowered.

(2) In order to supply a reactive gas to each electrode, the reactive gas passage (8) was made using the rib electrode substrate (6), but because the shape was complicated, forming this type of electrode substrate was troublesome.

(3) A ribbed electrode substrate is used in the electrode substrate for the single cell (1) and the reactive gas passage (8) for the fuel gas and the oxidizer gas is framed independently at each respective single cell, and since the separator (2) is sandwiched and stacked in order to isolate the reactive gas passages between adjacent single cells, the stacking height for entire body of the cell stack becomes high, and it is difficult to achieve compactness.

This invention was made to address these points, and by changing the alignment of the single cells that construct the cell stack, and skillfully constructing the reaction gas chamber by matching this alignment, the problems of the construction used in the past are solved, and the purpose of the invention is to offer a fuel cell construction that is more compact, and more reliable.

Means to solve the problems

In order to solve the problems mentioned, in the fuel cell of this invention is constructed such that in addition to forming gas chambers between single cells that come into contact so that the electrodes of the

same polarity are facing each other, a cross-over lead is lead out from the electrode at each single cell, and the single cells are mutually electrically connected through the medium of these leads.

This construction also has a common gas chamber, a reactive gas inlet and outlet, and is made frame shaped like a picture frame that corresponds to the electrode outer shape to that at least the face which contacts the single cell side electrode is electrically connected.

Function

According to this construction, at each common gas chamber, an electrode of the same polarity as the adjacent single cell is made facing opposite with the same gas chamber interposed. Therefore, for two single cells that are mutually adjacent, a reactive gas of the fuel gas and the oxidizer gas are supplied simultaneously to the fuel electrode and the oxidizer electrode of both single cells through the common gas chamber.

Also by means of this construction, it is not necessary to isolate the reactive gas chamber between adjacent single cells, the separator that was made necessary by the cell stack of the construction used in the past becomes unnecessary, and in place of the ribbed electrode substrate in which the shape became complicated, a flat gas permeable substrate is used as the electrode base material.

Furthermore, since it is made so as to electrically connect the alternate single cells through the medium of a crossover lead, the connecting wires between the single cells in the fuel cell internal section are not limited to a series connection, and as a result a selection of series or parallel connections becomes possible, and it is possible to design a large increase of the current capacity of the fuel cell by selecting a series/parallel connection depending on requirements.

Application Examples

Figure 1 is a cross-sectional construction diagram of a cell stack of a fuel cell according to an application example of this invention, Figure 2 is an outer perspective view of the frame that frames the common gas chamber in Figure 1, and the same reference numerals are applied to the same components in Figure 3.

In Figure 1, with respect to the single cells (1) that construct the cell stack, for its electrode base material, instead of the ribbed electrode substrate (6) shown in Figure 3, a gas permeable electrode substrate that is made as a flat plate indicated by reference numeral (60) is used.

The single cells that are connected together within the cell stack are aligned so that electrodes of the same polarity are aligned facing each other; in other words, fuel electrode (4) and fuel electrode (4), and oxidizer electrode (5) and oxidizer electrode (5) are aligned so as to face each other, and between the single cells (1), a frame (10) that frames the common gas chamber (9) is interposed. The structure of frame (10) is shown in Figure 2. In other words, frame (10) abuts the circumference of each electrode of the single cell (1) and is made in the shape of a picture frame in which the outer dimensions are determined so as to stack together, and on one its opposite facing edges a reactive gas inlet (11) is opened, and on the other, a gas outlet (12). Corrosion resistance is also high in the outer face is high of this frame (10), and it is made as a molded product of a phenol resin or metal that is coated with a fluoride group resin with electrical insulating properties. An end plate (13) forms a closing plate of the reactive gas chamber that is placed at both the top and bottom ends of the cell stack.

In this type of construction, the reactive gas is applied within the common gas chamber (9) from an external section through the gas inlet (11) of the frame (10). An oxygen-rich reformed gas that is used as the fuel gas is supplied to the common gas chamber through the fuel electrode (4), and air [is supplied] as an oxidizing gas to the common gas chamber through the oxidizer electrode (5). By this means, the

fuel gas passes through the common gas chamber and is simultaneously supplied to the fuel electrode (4) of two adjacent single cells (1), and in the same manner, the oxidizer gas is supplied simultaneously to the oxidizer electrode (5) of two adjacent single cells (1), and electromotively react at each single cell (1). Surplus gas is exhausted as off gas from gas outlet (12).

The example illustrated shows that the gas inlet (11) and outlet (12) to each common gas chamber (9) for the reactive gas are lead out aligned in the same direction, but by alternately changing the direction of the frame (10) shown in Figure 2 so that the gas inlet (11) and outlet (12) for the common gas chamber (9) mutually intersect between the fuel gas side and the oxidizer gas side, the fuel gas and the oxidizer gas can be supplied to the common gas chamber (9) from separate directions through a manifold that is arranged on the four sides of the cell stack.

A crossover lead (14) is let out each single cell (1) to the side from the end sections of its fuel electrode (4) and oxidizer electrode (5), and the single cells (1) are electrically connected together through the medium of this crossover lead (14). Connection examples are shown in the circuit diagrams of Figure 5 and Figure 6. Figure 5 shows a case in which high voltage is obtained by a series connecting all of the single cells, and Figure 6 shows a connecting example in which the current capacity is increased three times compared to that of Figure 5, in which assemblies of single cells that are connected three at a time in parallel are connected in series, and the current that is generated in each single cell (1) is taken out to an external section by conducting from the electrode to the crossover lead (14).

Effects of the invention

Because it is constructed as explained above, the fuel cell of this invention exhibits the following effects. That is, the single cells that are connected together within the cell stack are aligned so that electrodes of the same polarity are aligned mutually facing each other, and the common gas chamber is

interposed between them. At the same time, at each single cell, the crossover lead is let out from electrode, and the single cells are electrically connected together through the medium of this crossover lead.

(1) The separator used for reactive gas passage isolation that was installed between each single cell in the construction used in the past is made unnecessary, and by this means, trouble that arose in the past, cracking and damaging the separator when generating a reactive gas mixture is prevented, and the reliability of the fuel cell is improved.

(2) Instead of the complicated ribbed electrode base material used as the electrode base material of the single cell, a flat electrode base material can be used, and production becomes easy.

(3) Without independently framing the fuel gas passage and oxidizer gas passage, respectively, at each single cell, the reactive gas can be supplied simultaneously to two single cells at the same time through a single common gas chamber, and the laminated height of the entire cell stack can be reduced by jointly using the flat plate electrode base material of the single cell side.

Brief description of the figures

Figure 1 is a cross-sectional construction view of a cell stack according to an application example of this invention, Figure 2 is a perspective view of the frame used for framing the common gas chamber in Figure 1, Figure 3 is a cross-sectional construction view of a cell stack used in the past, Figure 4 is an equivalent circuit diagram of the cell internal parts according to Figure 3, Figure 5 and Figure 6, respectively, are equivalent circuit diagrams of cell internal connections showing different connection examples according to this invention. In the figures,

1 Single cell

3 Matrix layer

4 Fuel electrode

5 Oxidizer electrode

9 Common gas chamber

10 Frame

11 Gas inlet

12 Gas outlet

14 Crossover lead

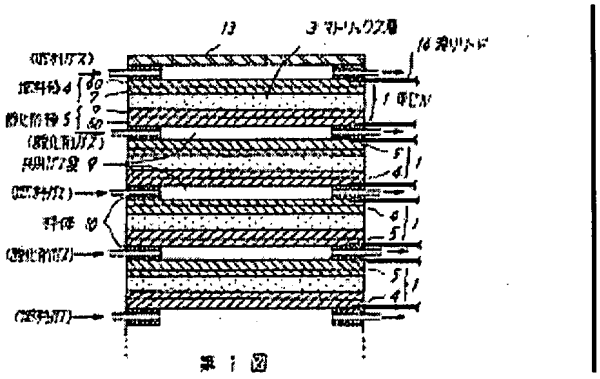

Figure 1

Key: 1 Single cell

3 Matrix layer

4 Fuel electrode

5 Oxidizer electrode

9 Common gas chamber

10 Frame

14 Crossover lead

15 Fuel gas

16 Oxidizer gas

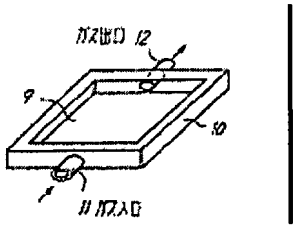

Figure 2

Key: 11 Gas inlet

12 Gas outlet

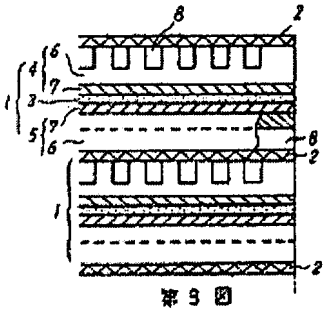

Figure 3

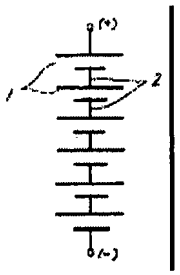

Figure 4

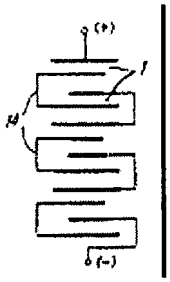

Figure 5

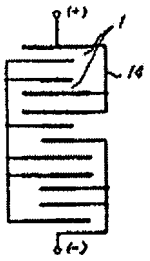

Figure 6